

spark-line radiation does not bring about the emission of the yellow *D* lines from sodium vapour. Work is in progress to develop the ideas expressed above.

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#### The Sligo Artefacts.

A LETTER in NATURE of Jan. 28 definitely establishes the human origin of the Sligo flakes, but the last sentence of the letter seems to suggest some mystery concerning their cultural age. In view of this it may not be superfluous to refer to the accompanying photograph (Fig. 1) which Mr. A. W. Stelfox has kindly lent us. The photograph (Fig. 1) was taken by Mr. R. W. Welch and shows a primitive limestone anchor similar to many that are still manufactured and used by the fishermen on the west coast of Galway. These anchors are made near the coast, and the resulting flakes are left lying about along

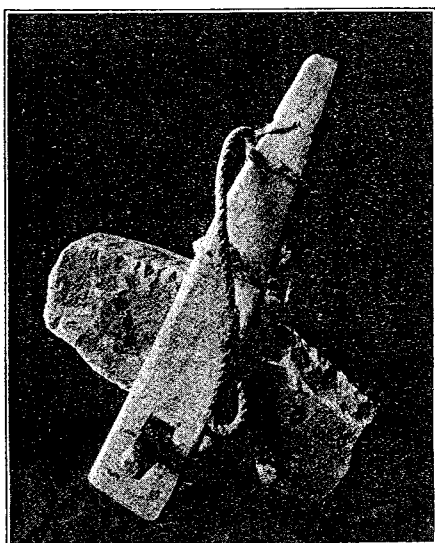


FIG. 1.—Primitive anchor, a heavy stone in wooden clamp, still used by Aran Islanders, west coast of Galway.

with larger discarded stones, all showing traces of their undoubted 'humanity.' Although no such anchors are now made at Rosses Point, it is highly probable, if not certain, that such stone anchors were made there, and also at many other parts of the Irish coasts one or two hundred years ago. In all probability the present beach on which the Sligo specimens were found was not in existence even a thousand years ago, so the possibility of the Sligo flakes being debris from primitive stone anchors should be taken into consideration when attempting to fix their cultural age.

These facts are no doubt known to the five signatories of the letter referred to, yet we think it worth while to place on record any evidence which might assist in the elucidation of the cultural age of the artefacts in question.

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#### Factors which determine the Occurrence of the Green Ray.

THE recent discussion of the green ray which has been appearing in NATURE prompts me to put on record a new theory of the phenomenon which occurred to me several years ago, but which I have refrained from publishing in the hope of securing proof. First let me say most emphatically that the phenomenon is real and not an illusion or after-image. No person trained in the observation of optical effects, both real and subjective, who has seen the phenomenon at its best, will have any doubt about its reality. There is also no question in my mind but that the usual explanation (atmospheric dispersion) is quite correct. The main question to answer is, Why is it seen so seldom, even under conditions which appear to be the most favourable?

I have crossed the ocean some thirty times and have looked for the 'ray' at every favourable opportunity, by which I mean clear sky, no haze or clouds on the horizon at sunset, and a calm sea, and yet I have observed it on only three or four occasions, and only once when it was really striking. This occasion was on an eastward trip of the *Homeric*, sailing from New York on June 6, 1925. The colour of the vanishing edge of the sun at sunset was a vivid emerald green, about the colour of a railroad signal light. On other occasions on which I have observed evidence of the phenomenon, the colour change was from red or orange to lemon yellow.

It seems possible that the determining factor is the relative temperature of the air and the ocean. Warm water and cool air would flatten the trajectory of the light rays, and cause the sun to set abnormally early. This is the type of refraction in cases of desert mirage, in which case the curvature of the rays is reversed. With cold water and warm air, on the contrary, the normal gradient of refractive index would be increased, the curvature of the rays augmented, and sunset would be delayed, giving a greater opportunity for atmospheric dispersion to come into play.

Through the courtesy of Capt. Parker, of the *Homeric*, I have been furnished with data regarding the air and water temperatures on this trip. On the day on which we observed the ray, the temperatures of air and water were practically the same at sunset. On the other three favourable evenings, on which we failed to see any trace of the phenomenon, the ocean was from twelve to fourteen degrees warmer than the air at sunset. I hope that this note may prompt future observers of the green ray to secure data on the air and water temperature, both for occasions on which it is not seen, as well as those on which it is well marked.

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#### A New Type of Secondary Radiation.

IF we assume that the X-ray scattering of the 'unmodified' type observed by Prof. Compton corresponds to the normal or average state of the atoms and molecules, while the 'modified' scattering of altered wave-length corresponds to their fluctuations from that state, it would follow that we should expect also in the case of ordinary light two types of scattering, one determined by the normal optical properties of the atoms or molecules, and another representing the effect of their fluctuations from their normal state. It accordingly becomes necessary to test whether this is actually the case. The experiments we have made have confirmed this anticipation, and

shown that in every case in which light is scattered by the molecules in dust-free liquids or gases, the diffuse radiation of the ordinary kind, having the same wave-length as the incident beam, is accompanied by a modified scattered radiation of degraded frequency.

The new type of light scattering discovered by us naturally requires very powerful illumination for its observation. In our experiments, a beam of sunlight was converged successively by a telescope objective of 18 cm. aperture and 230 cm. focal length, and by a second lens of 5 cm. focal length. At the focus of the second lens was placed the scattering material, which is either a liquid (carefully purified by repeated distillation *in vacuo*) or its dust-free vapour. To detect the presence of a modified scattered radiation, the method of complementary light-filters was used. A blue-violet filter, when coupled with a yellow-green filter and placed in the incident light, completely extinguished the track of the light through the liquid or vapour. The reappearance of the track when the yellow filter is transferred to a place between it and the observer's eye is proof of the existence of a modified scattered radiation. Spectroscopic confirmation is also available.

Some sixty different common liquids have been examined in this way, and every one of them showed the effect in greater or less degree. That the effect is a true scattering and not a fluorescence is indicated in the first place by its feebleness in comparison with the ordinary scattering, and secondly by its polarisation, which is in many cases quite strong and comparable with the polarisation of the ordinary scattering. The investigation is naturally much more difficult in the case of gases and vapours, owing to the excessive feebleness of the effect. Nevertheless, when the vapour is of sufficient density, for example with ether or amylene, the modified scattering is readily demonstrable.

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#### Land-locked Salmon.

THE term 'land-locked' is generally used for fresh-water colonies of salmon, such as that from the River Otrá described in NATURE of Mar. 17, and from Lakes Wenern and Ladoga, and even for the Canadian Ouananiche. The word is, in my opinion, misleading, indicating that the colony is cut off from the sea, which is not always true, and that it owes its formation to this circumstance.

The fact that Lake Wenern has a stock of salmon indicates that it was formerly accessible from the sea; when the falls first became impassable to ascending fish they could scarcely have prevented fish from descending had they wished, so that none would be left. It seems clear that in the days when the lake was accessible from the sea, and salmon went through it to spawn in its tributaries, some of the smolts that descended into the lake found it to be a sufficiently good substitute for the sea to stay there, and so founded a non-migratory race, which became isolated later. Similarly with the River Otrá; some of the smolts reaching the Bygglandsfiord were tempted to stay and feed on the abundant pelagic crustacea, and founded a dwarfed race of lake-salmon, that was isolated when the falls became impassable.

The trout forms fresh-water colonies in every river and lake that it enters, and for this species the term 'land-locked' is never used. On this side of the

Atlantic the salmon generally leaves such colonisation to the trout, and itself forms fresh-water colonies only in exceptional circumstances, either in very large lakes with abundance of fishes, or in rivers or lakes with such quantities of parr-food that it is tempted to prolong the parr life. In America, when there are no trout, the salmon form fresh-water colonies more readily.

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#### Anomalous Groups in the Periodic System of Elements.

IN a paper which will shortly appear in the *Rend. Accad. Lincei*, I have calculated the distribution of the electrons in a heavy atom. The electrons were considered as forming an atmosphere of *completely degenerated* gas held in proximity to the nucleus by the attraction of the nuclear charge screened by the electrons. Formulæ were given for the density of the electrons and the potential as functions of the distance  $r$  from the nucleus.

In continuation of the previous work, I have applied the same method to the study of the formation of anomalous groups in the periodic system of elements. From the density of the electrons and their velocity distribution, one can easily calculate how many electrons have a given angular momentum in their motion about the nucleus, that is, how many electrons have a given azimuthal quantum number  $k$ .

It is known, for example, that the formation of the group of the rare earths corresponds to the bounding of electrons in  $4_3$  orbits, that is, to the presence in the atom of electrons with  $k=4$ . Now it follows from the theory that electrons with  $k=4$  exist in the normal state only for atoms with atomic number  $z \geq 55$ . This agrees well with the empirical result that the group of the rare earths begins at  $z=58$  (cerium).

Similarly, the bounding of  $3_3$  electrons with  $k=3$  corresponds to the anomaly of the first great period beginning at  $z=21$  (scandium); according to the theory, electrons with  $k=3$  should appear in the atom just at  $z=21$ .

Further details will be published later.

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#### Activation of Ergosterol at $-180^\circ$ C.

WITH reference to the letter in NATURE of Mar. 24, p. 452, from Dr. Bills and Mr. Brickwedde, on the activation of cholesterol at liquid oxygen temperature, we may mention that we are now studying the production of vitamin D from ergosterol by ultra-violet radiation at various temperatures, and have obtained intensely active products at  $-180^\circ$  C. from weak alcoholic solutions immersed in liquid oxygen, as well as at higher temperatures up to  $+78^\circ$  C. Details will be published shortly. Our results therefore are similar to those of Bills and Brickwedde, and are made with the pure provitamin instead of with 'cholesterol.'

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